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The Chromatographic Separation of Molecules/Particles Using Optical Electric Fields

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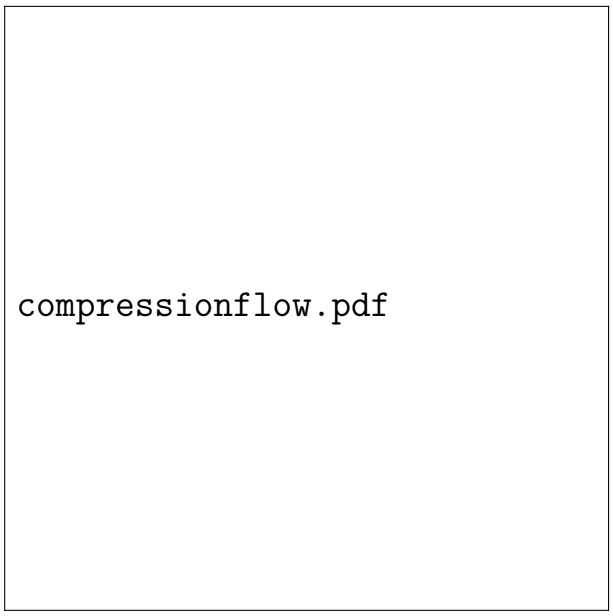
Abstract

r0.5 

Normalized surface coverage as a function of time at the onset of compression and/or flow. Three cases are considered: no change in equilibrium surface coverage, a new equilibrium surface coverage reached, or a catastrophic loss of adsorbed molecules. We introduce a new field-flow fractionation technique, whereby molecules are separated based on their differential interaction with optical electric fields, i.e. electric

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fields with frequencies in the visible and near-infrared range. When solute particles are introduced to electric field gradients they are polarized based on their size and refractive index. The resulting attractive or repulsive polarization potential influences a solute particles lateral position with respect to the gradient in electric field. By coupling well described optical electric fields with a non-uniform flow, we demonstrate how such potentials can be used to continuously separate nanometer scale solute particles in a flowing two dimensional microchannel. Comparisons are made for theoretical axially uniform optical fields and numerical simulations considering optical electric fields with finite width. We discuss the impact of the governing dimensionless groups on separation resolution and resulting solute concentration distribution after separation. An experimental apparatus is introduced and experimental results are put into the context of the theoretical results.